

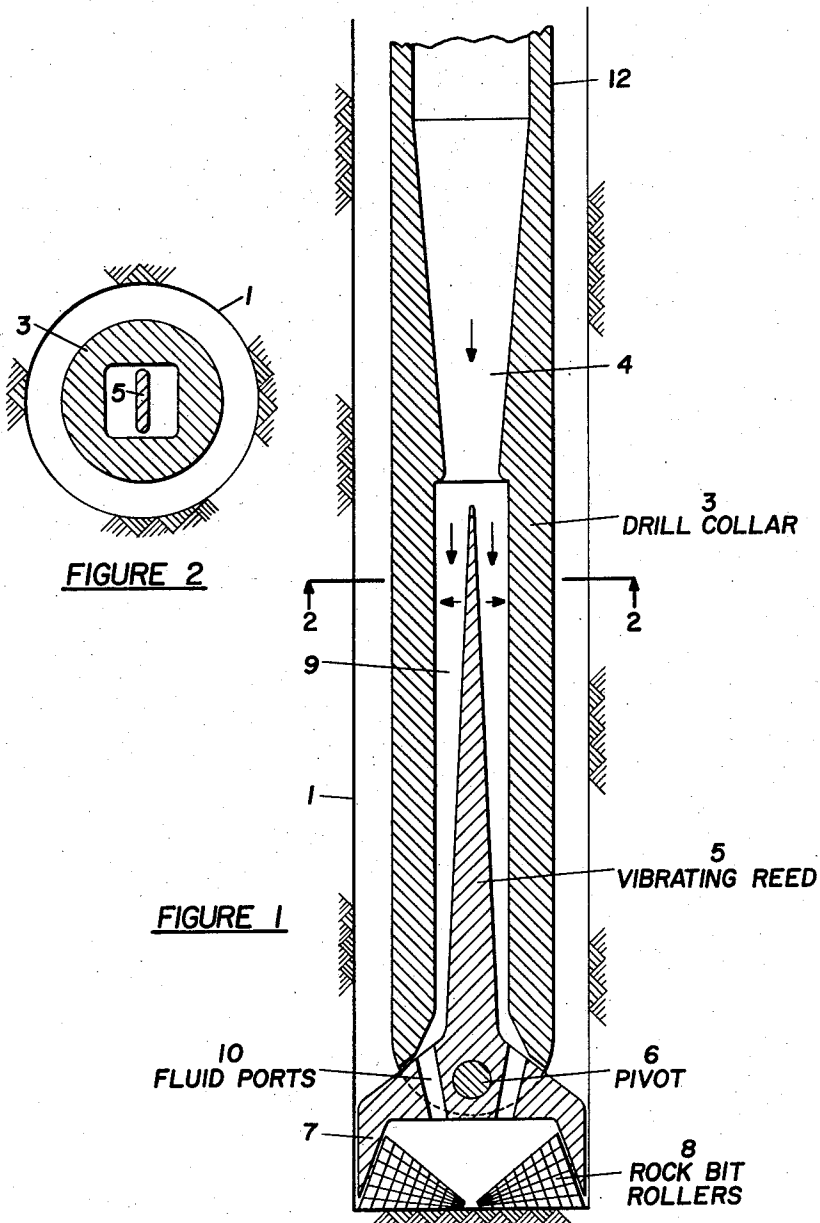
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VIBRATING BIT ASSEMBLY

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VIBRATING BIT ASSEMBLY

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The present invention is concerned with an improved method and apparatus for drilling well bore holes. The invention more specifically relates to an improved method of rotary drilling particularly when utilizing a rock bit. In accordance with the present invention, rock formations encountered in a drilling operation are subjected to alternating stresses in a manner to cause fatigue and failure of the rock. This is accomplished in accordance with the present invention, by utilizing a vibrating reed type of rock drill bit in conjunction with conventional drilling equipment.

In the exploration for oil, the art of drilling well bore holes into subterranean areas of the earth has been widely investigated and extensively developed. The techniques employed are many and a wide variety of drilling bits and associated apparatus have also been developed. One conventional procedure is to attach a suitable bit on the end of a pipe string and to rotate the bit by the rotation of the pipe string.

Thus, at the present time, the majority of drilling operations are conducted by employing rotary drilling equipment. In conventional rotary drilling, a hollow jointed steel shaft called the drill stem is rotated from the surface of the earth. This shaft, extending downwardly into the earth to any desired depth, rotates a drill bit. For a number of reasons there is attached to the lower end of the drill pipe, heavy sections of pipe termed drill collars. Also, for a number of purposes, a weighted fluid called drilling mud is circulated in one direction through the drill stem and in the opposite direction through the annulus between the drill stem and the bore hole wall.

In these drilling operations, it is known that rocks subjected to alternating stresses will fail rapidly in fatigue. This effect is responsible to some extent for the action of conventional rock bits, wherein toothed cutters rolling on the surface of the rock impart alternating stresses to the surface of the rock, resulting in chipping, fracturing, and crumbling of the rock being drilled. The conventional rock bit, however, depends to a very great extent for its cutting action upon compressive stress induced by excessive weight on the bit. This is secured by allowing the weight of the drill string to partially rest on the bit. This process while satisfactory has a number of inherent difficulties. For example, part of the drill pipe may be in compression resulting in buckling of the pipe which in instances causes the hole to deviate from the vertical. Furthermore, the stress induced due to the buckling and unbuckling of the compressed pipe results in fatigue failure. To reduce this difficulty, drill collars, which are heavy lengths of pipe, are used. These are expensive, and are subject to frequent failures. Another disadvantage is that the friction against the walls of the hole causes the drill pipe to wind up with the result that a substantial amount of bouncing of the bit occurs on the bottom of the hole. This aggravates the wearing of the cutter bearings in rock bits. Thus, this is not an efficient way to induce alternate stresses of the magnitude and frequency required for efficient use of

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the mechanism of fatigue failure in the rock drilling operation. The present invention is concerned with a device adaptable for use on the conventional rotary drilling rig which provides for a vibrating reed type of impact aid for rotary drilling in a manner to secure high frequency impact to the formation being drilled.

The present invention may be more fully understood by reference to the drawing illustrating an embodiment of the same in which Figure 1 illustrates a vertical sectional view showing a vibrating bit assembly, and Figure 2 is a cross-sectional view on 2—2, Figure 1.

Referring specifically to the drawing, a drill bit assembly is shown disposed in the bottom of bore hole 1. The drill bit assembly is suitably attached to the bottom of a drill stem or string 12. The assembly comprises a drill collar 3 which contains element 4, a venturi nozzle to direct fluid impingement upon the wedge-shaped upper edge of the reed element 5, suspended therein. This reed element is pivoted at 6 to the lower end of the drill collar. The reed element has attached to its lower end by suitable shanks 7 roller type, frusto conical rock bit elements 8.

When the apparatus of this invention is in a drilling position at the bottom of a borehole, a downward force occasioned by the weight of the drill string (and any additional applied force) is transmitted through pivot 6 to shanks 7 and thence through rock bit rollers 8 to the bottom of the borehole. Thus, while reed element 5 is pivotally supported from drill collar 3, substantially no pivotal movement of the element is possible under these conditions. In other words, any tendency of the reed element to revolve about pivot 6 is resisted by virtue of the fact that bit rollers 8 are firmly supported by the bottom of the borehole.

In operation, fluid is pumped down within the drill stem and into the drill collar. The fluid flows through a channel 9 about reed element 5. The fluid flows through ports 10 into the space about the rollers and the space between the outer wall of the drill bit assembly and the wall of the bore hole. The fluid passes to the surface in this latter space. In operation, the front or top sharp edge of reed 5 will split the stream of fluid as it leaves nozzle 4, thus vibrating reed 5 within space 9, imparting vibrating motion to the rollers on the rock surface being penetrated.

While the precise measurements of the assembly may vary appreciably, a suitable assembly is one wherein the reed element is about 4—6 feet long. The diameter of the area 9 may vary from about 3—7 inches. For instance, a very satisfactory diameter is one of about 4½ inches and wherein the dimensions of the reed at its upper end are about ¼ by 3 inches. Thus, such a reed will move back and forth in an area having a diameter about 4½ inches. In general, the assembly is designed so as to move the rollers from about ⅛ inch to ¼ inch off a horizontal plane. In general, the diameter of area 9 is about ½ the diameter of the pipe string. Thus, with respect to the bit assembly described, the drill collar will have a diameter of about 8 inches and the bit will drill about a 9 inch diameter hole.

In general, the design will be such as to produce vibrations within the range of frequency about 50 to 100 per second, although the practice of the invention is not limited to this range. The fluid will be pumped down the drill pipe, through venturi nozzle, channel containing the reed, fluid ports jetting onto rock face being drilled and return up annulus between drill pipe and wall of bore hole. When fluid leaves the venturi nozzle and impinges on the wedge shaped upper edge of the reed, a portion of the pressure energy of this fluid will be converted into vibratory energy. Any suitable fluid may be used, including, oil, air or gas. The preferred fluid employed would be a liquid. Vibrations thus set

up in the reed will then be transmitted by movement of the lever arm consisting of the reed around a pivot to rotatable drill bit cone elements.

What is claimed is:

1. In a rotary drilling system including a drill string with a drill collar at its lower end and a drill bit positioned below the drill collar, the improvement which comprises a reed element longitudinally disposed within said drill collar, the lower end of said reed element attached to said drill bit and pivotally supported about a lateral axis from said drill collar such that said reed is substantially axially disposed within said drill collar when the axis of said bit substantially coincides with the axis of said collar, the interior portion of said drill collar above said reed element having an axial restricted passage thus defining a nozzle adapted to direct any fluid flowing down through said collar against the upper edge of said reed element.

2. In a rotary-type borehole drilling assembly including a drill string and a drill bit, the improvement which comprises a drill collar positioned between said string and said bit and attachable at its upper end to the lower end of said string, a reed element arranged within and longitudinally of a lower portion of said drill collar, laterally disposed pivot means supporting said reed element at an intermediate point along its length from said drill collar such that said reed is substantially centrally disposed within said drill collar when the vertical axis of rotation of said bit when said drill collar is in an upright position is aligned with the longitudinal axis of said collar, a portion of said drill collar above said reed element having an axial restricted passage thus defining a nozzle adapted to direct any fluid flowing down there-through against the upper edge of said reed element, and the lower end of said reed element attached to said bit.

3. An improved vibrating drill bit assembly for use with rotary drilling apparatus for drilling boreholes in which a drilling fluid is passed downwardly through a drill string, which comprises: a drill collar adapted to be attached at its upper end to the lower end of said drill string and in fluid communication therewith, a reed element disposed longitudinally within said drill collar, a bit below said drill collar attached to the lower end of said reed element, laterally disposed pivot means adapted to support said reed element at an intermediate point along its length from said drill collar, said reed and said pivot means designed such that said reed is axially disposed within said drill collar when the axis of said bit is substantially aligned with the axis of said collar a nozzle supported by and within said drill collar and arranged to discharge fluid axially within said collar and above the upper end of said reed element so as to direct fluid flowing down through said drill collar against the upper edge of said reed element.

4. An improved vibrating drill bit assembly for use with rotary drilling operations for drilling boreholes in which a drilling fluid is passed downwardly through a drill string which comprises a drill collar adapted to be attached to the lower end of said drill string and in fluid communication therewith, said drill collar having a pivot element across the lower end thereof and an axially disposed nozzle in its upper portion, a vibratable member within said drill collar having an upper elongated wedge-shaped reed portion with a sharp edge and shank elements integral therewith and with said shank elements being without said drill collar and having attached thereto drill bit elements, said vibratable member being pivoted about said pivot element, said vibratable member and said pivot element being so designed that when said drill collar is in a vertical position and with said bit elements positioned upon the bottom of said borehole said sharp edge intersects the center of the projection of said nozzle whereby when fluid is passed downwardly through said nozzle said sharp edge splits the stream, thus vibrating said reed portion thereby imparting a vibrating motion to said bit element.

5. An improved vibrating drill bit assembly for use with rotary drilling operations for drilling boreholes in which a drilling fluid is circulated downwardly through a drill string which comprises a drill collar adapted to be attached to the lower end of said drill string and in fluid communication therewith and being further characterized by having a pivot element in its open end opposite said drill string, said drill collar also being further characterized in having a venturi nozzle axially disposed in its upper portion, an elongated reed element having a sharp front edge at one end within said drill collar, said reed element having integral therewith at its other end shank portions with said shank portions being pivoted about said pivot element and being without said drill collar, said shank elements having attached thereto bit elements and with said shank elements being further characterized in being symmetrical with respect to said pivot element whereby when rotary drilling operations are in progress said bits are rotated unidirectionally on the bottom of said borehole by the turning of the drill string and drilling fluid is directed through said nozzle to impinge on said sharp front edge thereby vibrating said reed element and imparting a vibrating motion to the rotating bit element.

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